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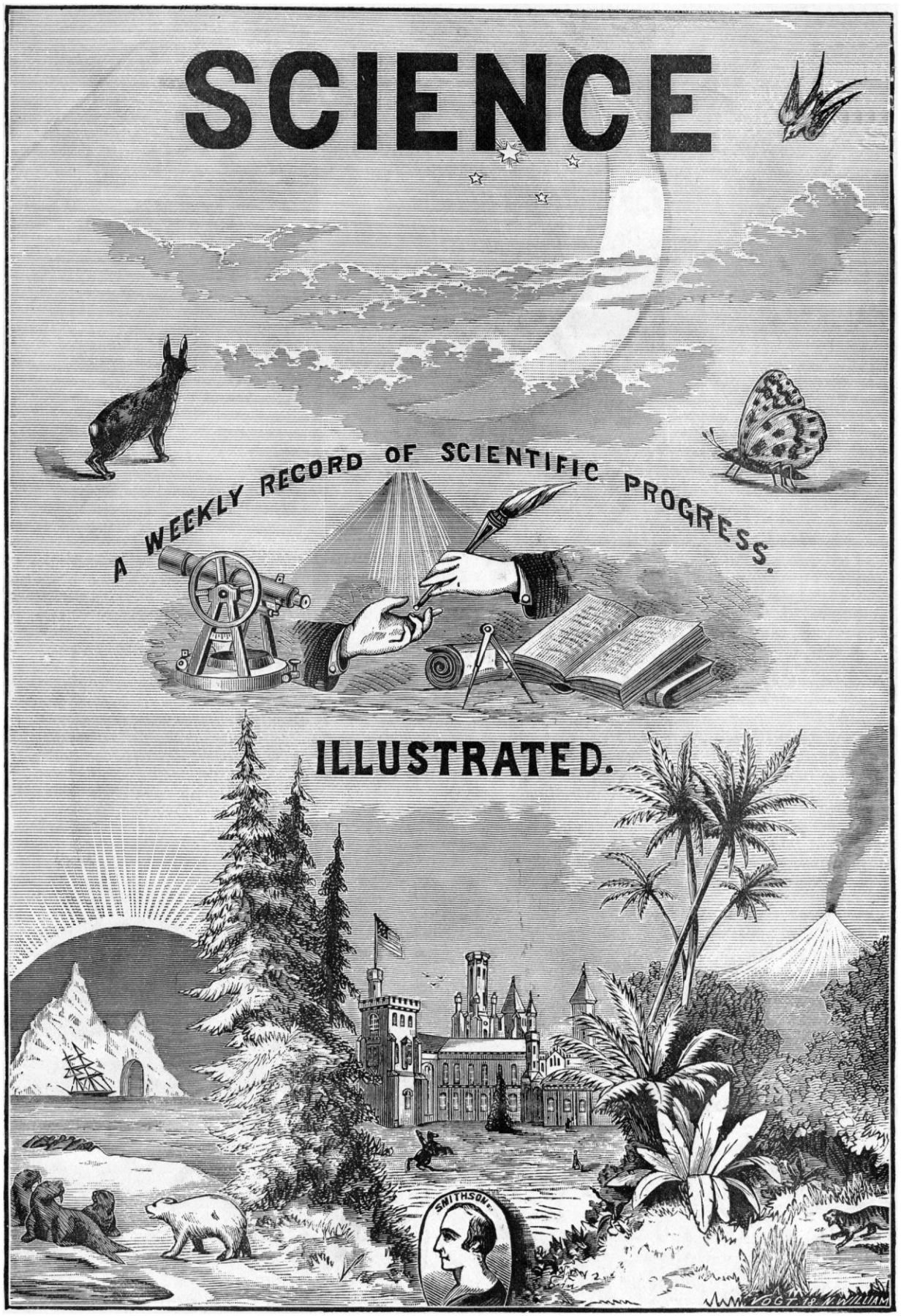

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"SCIENCE—A Weekly Record of Scientific Progress." It is a handsome, well-printed quarto sheet of 12 pages, with 4 addditional pages for advertisements serving as a cover. It counts among its list of contributors Professors Baird and Coues, of the Smithsonian Institution; Holden, of the Naval Observatory, Washington; Marsh, of Yale; Wilder, of Cornell; Young, of Princeton; Abbe, of the Signal Office; Morse, of Salem; Drs. Hammond and Spitzka, of New York, and a considerable number of well-known scientific experts. IT CLAIMS, WITH TRUTH, TO OCCUPY A HITHERTO UNOCCUPIED FIELD IN AMERICAN PERIODICAL LITERATURE, AS THE ONLY FIRST-CLASS WEEKLY JOURNAL IN THE UNITED STATES DEVOTED TO SCIENCE.

SCIENCE

A WEEKLY RECORD OF SCIENTIFIC PROGRESS.

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SCIENCE:

A WEEKLY RECORD OF SCIENTIFIC PROGRESS.

JOHN MICHELS, Editor.

PUBLISHED AT

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SATURDAY, JULY 2, 1881.

THE NEW COMET.

The great comet which has so suddenly flashed into our Northern sky is one of the most brilliant comets that has appeared for many years. It has a large and very stellar like nucleus which is surrounded with envelopes, very much like those of the Donati comet of 1858, which was described so well by Professor George P. Bond of the Harvard College Observatory. The dense nuclei of such comets give one the idea of a mass and quantity of matter quite different from the ordinary telescopic comets, through which the faintest stars can be seen. The tail of the present comet is now about twelve or fifteen degrees in length, and altogether this comet presents a very beautiful spectacle at three o'clock in the northeastern morning sky. The motion of the comet is three or four degrees toward the north, and it will soon reach a position where it will be visible during the entire night in the greater part of the United States.

The first duty of the astronomers will be of course to get observations of its positions and to compute the orbit of the comet. Since for this purpose observations on three days are sufficient, we shall soon have a certain knowledge of its motion. The knowledge of the orbit will decide the question whether this is the large comet whose discovery was telegraphed to Europe from Buenos Ayres by Dr. B. A. Gould, on June. 1st, and also whether it is identical with the great comet of 1807. The observations of the comet of 1807 were discussed in a very complete manner by Bessel who found its periodic time to be between 1400 and 1900 years, and it will be a curious fact if the true period proves to be only seventy four years.

This great comet also presents a good opportunity for the spectroscopists to examine its chemical nature, and a rare occasion for the study of the physical constitution of comets. No doubt these questions will be well attended to by the astronomers and students of our country.

The question of the formation of a comet's tail, and how the particles of matter are driven out from the nucleus in the direction opposite the sun has not yet been answered in a satisfactory manner, and all the facts that can be gathered from observations of this comet will be extremely valuable. In his discussion of the physical constitution of Halley's comet in its appearance of 1835 Bessel found that a repulsive force from the sun was very decidedly shown by the observations of the tail. Similar results were reached by Professor Pierce of Harvard College, Professor Norton of Yale College and by Dr. Pope in their discussion of the Donati comet of 1858. This is an interesting question and it may have an intimate relation with the theory of a resisting medium in space which has been indicated by the motion of Encke's comet.

We learn that unfortunately the weather at Washington has been unfavorable for several days past; but from the numerous good telescopes scattered over the country, we doubt not that good observations of this interesting comet will be gathered.

THE ADDRESS OF THE PRESIDENT OF THE ROYAL MICROSCOPICAL SOCIETY.

LIONEL S. BEALE, F. R. S.

(Concluded from page 297.)

One may transport oneself in imagination into infinite space, amid the never-ceasing vibrations visible and invisible—"The lucid interspace of world and world, where never creeps a cloud, or moves a wind," and may perhaps all but see combined in one mental image, as they ever course through space, suns and worlds and systems. And although at first the mind is almost lost in the contemplation of the infinite physical vastness presented it, it is nevertheless able to seize in some degree a more than shadowy conception of the exactness and regularity of the eternal movements, and to recognize the never-ceasing operation in the material universe of inflexible, unchanging law.

But he who in imagination can succeed in mentally placing himself amid the atoms in the interatomic spaces of a living particle, will be in the very heart as it were of an infinity of a very different order—infinite movement and change affecting infinitely minute particles, so very near to one another that the matter of one may as it were run into that of the other, and the masses divide and subdivide again. Of all this movement and change of particles how very little of what occurs in a portion of matter not more than the one hundred-thousandth of an inch in diameter can be comprised in one mental image? But beyond all this there is the power of prospective change, acting through years it may be, which is somehow associated with the minute particles of living matter, as well as many complex phenomena of which the mind cannot take cognizance as a whole, but must consider, as it were, one by one in several successive pictures.

Could we peer into the very substance of the living particle itself as it was increasing in size and communicating to non-living matter its wonderful properties, what should we see? What is it that happens at the moment when a little complex organic matter dissolved

in water passes from the non-living to the living state? Should we see atoms being arranged and entering into new combinations according to some physical properties inherent in the very matter—atoms combining according to their chemical affinities; or should we see the complex chemical compounds of the pabulum being changed, their elements being somehow torn asunder from their combinations, or rather quietly separating from one another in obedience to some force or power of which we cannot form any accurate conception? The most extraordinary active atomic movements must be taking place, and in the quietest possible manner. Certainly the phenomena which accompany ordinary chemical decompositions in non-living matter do not occur. No two things in this world can be more dissimilar than man's chemical laboratory and nature's laboratory in this living matter. That the formation of the germ is to be accounted for by the operation of the ordinary forces of matter is one of the most absurd of absurd propositions; but that the idea of such an origin should still be entertained and taught by a physicist or chemist is unaccountable.

There are no actions in non-living matter with which the actions of living matter can with any degree of fairness or accuracy be compared. No argument in essential particulars can be pointed out which would justify the use of the word "analogy" without doing violence to truth and cheating the reason. To maintain the identity of the vital and inorganic forces on the ground of some fancied analogy between vital action and crystallization is most wrong and willfully misleading, for the fallacy has been many times exposed and exploded. Been a crystal and living matter there is not the slightest analogy, for the one can be destroyed and caused to re-form as many times as we like, while the living matter cannot be even dissolved. In the attempt to dissolve it, it dies, and cannot be reproduced.

It is obvious that before particles of living matter pass from the living into the formed state their component atoms, or groups of them, must somehow be made to take up a definite position with respect to one another. Such changes of place as must occur can only be brought about by some peculiar force, property, or power, the action of which is temporary. Seeing that the changes in question can take place only while matter is in the temporary living state—this matter having been detached from matter in the same living condition—the force or power in question must be of an exceptional nature, and of an order different from that to which the ordinary forces or powers of non-living matter belong. This wonderful living power which is postulated causes the atoms or the particles of the matter to take up certain positions favorable to their combination in a certain definite manner. Thus certain substances are formed which have a peculiar chemical composition, and in certain cases special properties and endowments not possessed by substances that can be formed in any other way. It seems to me it would be as unreasonable to maintain that the bricks, or rather the clay of which they are made, or the silica and alumina of the clay, or the properties of the elements entering into the composition of these substances, design, fashion and build the house, as to assert that the formation of living things is due to the physical properties of the materials of which their bodies are composed. Vital power impresses as it were its seal upon the matter—upon the structures of the living organism—and ought surely therefore to be considered as above and superior to the mere stuff that it moulds. Vitality, or vital power, forces, bends, arranges, and fashions just as man himself moulds and fashions the clay he works with, only silently, invisibly, more perfectly, and in a definite and prearranged manner, and without mind or will or ingenuity, or instruments or organs,

Judging from the facts, is it not indeed more probable that the ordinary properties, the attractions, the affinities of mere matter are in suspension rather than in action, while the matter continues to be in the living state? When these properties and affinities come into play, do we not get from the matter that was alive albuminous matters, fat and other things, of known properties and definite composition? But neither these nor any definite compounds existed when the matter was living. They came into being at the moment of its death. The idea of these substances existing in the living matter is inadmissible, for if they were there, some of them could be demonstrated. Such a substance as fatty matter cannot, of course, exist in the living state; fat cannot grow and form fat out of materials which contain the elements of the substance in different states of combination, any more than granite can. If it be conceded that during the living state the ordinary properties and affinities of the matter are suspended, it will be admitted that none of the ordinary properties of material particles can be reasonably credited with the ability to interfere with the exercise of affinities; and therefore it seems reasonable to conclude that some totally different power, *vitality* or *vital power* (which same, unlike the ordinary properties of the matter, is lost or ceases to act when living matter dies), is the true cause of the exceptional state in which the material particles are held while the matter remains living.

But thought may take us yet further. Gradually passing inwards towards the centre, through vast concentric layers of particles, we arrive at last in imagination near the centre of a particle far too minute to be visible, where the atoms of lifeless matter first live. As to the actual nature of this wonderful change which occurs, we are, and from a purely physical point of view must remain, in darkness. For it is certain that the new temporary living state is absolutely district from the non-living state in which the matter existed but an instant before. Before long this will, I doubt not, be generally admitted by those acquainted with the facts and not biassed by previous confessions or beliefs.

It is invariably in living matter devoid of structure and form, that all those wonderful actions of surpassing interest which result in the development of form the most striking and structure the most elaborate, are carried on. Forces or powers, but of a non-material order, transmitted through succeeding particles of the same kind, and continuously operating, it may be upon vast quantities of matter, through centuries or centuries of centuries (millions on millions of years"), are the activities by which the re-arrangement of the elements under certain fixed conditions which eventuate in definite and predetermined form, structure, and composition, is brought about. The changes, conversions, formations in question, at present invisible and undemonstrable, require considerable time for their completion. Compared with the visible phenomena which succeed them, and which may be watched, described and delineated by us, they are slow indeed. During days, weeks and months, in darkness and in silence, arrangements and re-arrangements of the most complex character incessantly and quietly proceed, as we say, in obedience to *laws* (though we do not *know*), ere the first visible traces of the new being can be discerned by the most careful investigation.

Remember that the changes in question affect a mere modicum of matter. A grain, nay, the hundredth, the thousandth part of a grain, and far less than this may at one time constitute the material substance from which springs a tree that in its maturity will comprise tons of matter, every grain of which will be stamped with individuality. Is it not, then, most strange that in these days which surpass all previous time in the passion exhibited by men to see into the nature of things, that attention should be so much absorbed in considerations relating to the mere matter of which a living thing is made, while the study of the forces and powers which have effected the forming and shaping of the material substance is not only almost wholly neglected, but positively discouraged?

And yet these forces or powers fashion the germ and cause it to be like its predecessors, or modify its character and cause it to give rise to forms perhaps not before attained. With what shall these forces of the living world, operating so marvellously upon infinitesimal particles of matter, be compared? The changes have been likened to those which take place in the formation of crystals, which can be dissolved and caused to re-form as often as we choose; to the aggregation of particles of lifeless matter which can be made to separate or aggregate as we will; to machines which are made by us in separate pieces and afterwards put together; and to many other things between which and living particles there is not the faintest resemblance or the slightest analogy. Uninquiring, unthinking persons have been, and are at this time, misled by crude and false comparisons, and deceived by forced and fancied analogies. The coarse materialism of our day ought long ago to have been dismissed with scorn as unworthy of the age in which we live, and of the acceptance of any one who would not disgrace himself by helping to force thought back again to the point it had reached more than two thousand years ago.

No one acquainted with the facts of vital change can doubt that phenomena of the same order as those in operation to-day attended the development of primeval forms of life. For not only do we meet with living matter producing the same structures as existed during early periods, but it is probable that some of the living things now growing and multiplying are identical with some that existed in the very dawn of life-history. Unbroken *continuity*, *descent*, *derivation*, in operation through the ages without change in power or property, or alteration in form or composition; *repetition* without gain or exaltation; *continuous descent* without degradation or improvement; monotonous succession without progression or advancing evolution. Nevertheless, we are expected to accept the dictum that amid these myriads of myriads of similar organisms, here and there one more fortunate or more gifted than the rest—we are not told why, when, or how—became endowed with the marvellous power of endless modification. We are asked to believe that rigid laws uniformly operating with the same consequences, for ages, suddenly changed, and that long-imposed uniformity gave place to capability of differentiation. But if we try to realize what, according to the terms of the hypothesis must have happened in the living matter, into what a sea of fantastic conjecture do we plunge! The new or modified powers must have originated in or emanated from particles in the very centre of minute living spherules. When we consider the minuteness and insignificance as far as the mere matter is concerned, of the living particles we are referring to, many will, I think, be inclined to admit that it is at least as probable that new forms of living matter of this infinitesimal minuteness originated anew, as that forces which had been in operation for ages, under inexorable unchanging laws, were entirely and suddenly changed or removed, and replaced or supplemented by additional and very different forces obeying very different laws.

Moreover, as no direct or positive evidence of a reliable character has yet been obtained in favor of the direct conversion of non-living matter of any kind into a living form, while there is nothing to indicate that the passage from the non-living to the living was effected by gradual change, as has been suggested by some, it is as reasonable to assume that several infinitesimal life-forms with very different powers of development sprang at once into life, though the ultimate form to be assumed was postponed for ages, as that one single living form only was so formed with the power both of endless monotonous repetition, as well as of infinite and never-ceasing capacity of variation and change, one or other of these opposite attributes being accidentally exercised or capriciously taken advantage of by such of the descendants as were assured that they were above all the most fitted to survive.

Doctrines of evolution are, no doubt, an advance upon the direct mechanical formation of fully formed organisms hypothesis; but although some evolutionists have so expressed themselves as to lead us to infer that an idea so absured as the above had been entertained, it need scarcely be said the inference is their own and totally unfounded, suggested by themselves for the satisfaction of ridiculing it and exposing its inferiority to their own hypothesis. No doctrine of evolution yet put forward seems to afford any help to those who are familiar with the characters of the living matter of different organisms, as far as these can be elucidated by any means at present known. Evolutionists generally do not take cognizance of the difficulties which are so patent to microscopical observers. Some of them have hardly condescended to notice the living matter, out of which and by which all the forms of life they profess to account for are developed. It is true that it has been suggested that there are structural differences in the apparently similar manner, which structural differences result in the production of such dissimilar beings; but speculations concerning hypothetical structure are as futile as those which deal with the hypothetical form and properties of the hypothetical inhabitants of Jupiter.

All living matter is, I repeat, structureless, and it is to the power rather than to the mere matter we must look for the explanation of the marvellous differences in the beings evolved by different kinds. The similarity of various embryos of different animals has often been alluded to, and it has been said, for example, that at a certain period of development the embryo of man could not be distinguished from that of a dog. That there is a general rough resemblance is perfectly true, but, on the other hand, any one who examined the minute structure of corresponding tissues and organs, would not find the likeness so great as is supposed, while he would be struck with a great number of points of difference. Not one structure could be found in any part of one embryo which did not exhibit peculiarities by which it could be distinguished. It would, therefore, scientifically be more correct to say that the embryos were *not like one another*, than that *they were like*. But any argument based upon the likeness, if it existed, would not help the evolutionist, inasmuch as the "likeness" is far greater at an earlier stage of existence, before any form or structure whatever has appeared. Every living form comes from an equally structureless material, and the forms near one another in the scale are not more like one another than they are like forms far above or far below them. If, for example, the evolutionist would examine embryonic living matter at a very early period of development, he would discover not only that man and dog were not to be distinguished, but that not one form of living matter could be distinguished from any other form in nature; nay, the living matter which might become dog or man could not be identified by any means at our disposal, or distinguished from that which belonged to amœba or plant, and yet it is put forward as a discovery of recent date that certain properties manifested by the tissues of animals also characterize some of those plants.

But after all, the assumed likeness is but a likeness in certain general points, and those who wish us to draw certain conclusions from their statements, ought to be asked to point out how it is that every cell, every issue of the embryos they regard as being alike or identical, exhibits peculiarities and individual characteristics of its own as regards elementary arrangement, rapidity of formation, rate of growth, duration of existence, and a number of other points. Again, the statements about the changes occurring during development in the lower animals being represented by identical changes occuring during the earlier periods of development in the higher, are correct only when taken in a very rough and general

way. Such phenomena, it is said, show unity of plan, and favor the hypothesis of the descent of jelly-fishes from sponges, and of man from apes. No doubt they do if the mind is already prepared to receive such ideas, Those, however, who really study the operations of nature in her inner recesses where and while she is at work, will certainly often find where identity is affirmed, diversity really exists. Rough general resemblances can no doubt be pointed out, and be made much of, by those who do not look too closely or intently; but those who examine minutely and patiently will find that in very many cases the general resemblances will be outnumbered and outweighed by specific irreconcilable differences and individual peculiarities.

If then we examine living matter in that early period of development ere any structural peculiarities whatever have been manifested, we shall be face to face with the problem of life. For it is at this time, when the matter is without form, that the dispositions of the material particles, which at length result in the development of form, are made. Preparation is made for the division of the mass of the living matter into several portions, and for the orderly disposition of these in respect to one another, as well as in respect of the new masses which at some future time are to be detached from them. Throughout the whole period of the life of many organisms, similar wonderful changes are continually taking place, at least as respects the living matter of certain parts and organs; but we have no means of distinguishing the living matter which continues monotonously repeating similar changes, from living matter which divides and subdivides into masses, which in turn gives rise to successive generations of living particles, which may differ from one another and from all that have gone before, in *power*.

As far as I am aware, no form of the doctrine of evolution yet enunciated takes into account the phenomena of the living matter in which and by which all the changes recognized and professed to be explained are carried on. And yet it is only by these actions in living matter that evolution can be made to appear a plausible hypothesis. Only by carrying out very careful investigations on this formless, structureless living matter can we reasonably hope to obtain anything approaching an accurate conception of the wonderful working of real living nature. It seems to me that the "nature" of the evolutionist is but a fanciful and highly colored picture in which ideas suggested by investigations in stockyards and shambles are depicted, with the addition of the horrible scenes assumed by a vivid imagination to be enacted in the supposed everlasting fight for existence and scramble for mastery, in which conquerors are always being conquered by creatures just a shade more fitted to survive than themselves. Here is creation by destruction in a never-ceasing scramble going on for millions on millions of years, in which the only thing certain seems to be that the greatest misery is assured to the greatest number; life succeeding life, without good or reason or joy or hope; peaceful nature a continual massacre of experimental forms to be massacred in their turn, and these by more; a constant struggle to survive, in which success is rewarded by extermination. The "nature" of evolutionists is a very strange nature indeed, in which oppression, destruction, and tyranny seem to be the chief agents in creation and formation, development and advancement.

But besides the evolution of living forms and of the different organs, we are to believe in an evolution of matter. an evolution of worlds, of suns, of systems. Religion, law, and justice, art, science, and even thought are all products of this universal, never-ending evolution. But what is evolution, and who has given to the term an accurate definition? We shall be told there is evolution and evolution. One man's evolution goes too far, another's not far enough, and there is no general agreement as to what is meant by evolution, and whether the use of the term should be restricted to the living world or extended to the universe—though it must be obvious to any one who considers the question that the evolution of a living form and the evolution of the matter of a stone are as far removed from one another as are the question of the nature and scope of Infinite Power and the nature and properties of a gas or a metal.

Herbert Spencer has defined his "evolution" to be a change from an indefinite incoherent homogeneity to a definite coherent heterogeneity, through differentiations and integrations. But is not every one of these polysyllabic words as elastic as the word the meaning of which they are to explain? Every assertion made is wanting in proof, and most of the words may be used in totally different and even in opposite senses.

Any one who ventures to express a doubt concerning the absolute correctness of the assemblage of vague and even contradictory conjectures comprised in any hypothesis of evolution, is in danger of being abused and called names. He may be denounced to the world as a contemptible person who has made a vile and abusive attack upon some infallible authority who affirms himself to be the real discoverer of all the secrets of all the molecular machinery of creation. We now live under the most ridiculous of all forms of despotism. It has been said that we must accept such and such views or be debarred from accepting anything! But is it possible for any unbiassed person to accept implicitly doubts, vague suggestions of what may be, or can be, or might be—speculations, hypotheses, conjectures concerning things that lived under conditions which are in great part only conjectural? Probably no living person accepts as it stands 'The Origin of Species,' and it is doubtful whether the first chapter, or even the first sentence of the first chapter, would hold its ground without considerable alteration and qualification if subject to searching critical examination.

The facts known to microscopical observers in connection with the act of living of the smallest particle of the simplest forms of living matter are no more to be accounted for by any of the extravagant crotchets lately advanced as explanations of the facts, than are the general broad phenomena of nature which are under the observation of all. Evolution is a wholly satisfactory explanation only to those whose minds have been trained to submission to evolutional authority, and who have brought themselves to regard things as they have been told they ought to regard them, instead of venturing to use their senses, and reasoningt on the facts presented to their observation—and indeed see for themselves with their own eyes instead of accepting, without ever seeing, what they are told has been seen by eyes which are supposed to be specially privileged to see.

As evidence of the nonsense often advanced in favor of some form of evolution, let me quote a few sentences from an article on "Butterfly Psychology," published in the *St. James's Gazette*. Like most advocates of evolution, the writer has the knack of telling his story in such a pleasant way as to make people imagine that he is explaining the nature and cause of things he describes, while in truth he is doing nothing of the kind. He explains nothing at all, but merely announces astounding assumptious based upon conjectures of his own, or of others.

"In early life the future butterfly emerges from the egg as a caterpillar. At once his many legs begin to move, and the caterpillar moves forward by their motion. But the mechanism which set them moving was the nervous system, with its ganglia working the separate legs of each segment. This movement is probably quite as automatic as the act of sucking in the new-born infant. The caterpillar walks, it knows not why, but simply because it has to walk. When it reaches a fit place for feeding, which differs according to the nature of the particular larva, it feeds automatically. Certain special external stimulants of sight, smell, or touch set up the appropri-

ate actions in the mandibles, just as contact of the lips with an external body sets up sucking in the infant. All these movements depend upon what we call instinct—that is to say, organic habits registered in the nervous system of the race. They have arisen by natural selection alone, because those insects which duly performed them survived, and those which did not duly perform them died out. After a considerable span of life spent in feeding and walking about in search of more food, the caterpillar one day found itself compelled by an inner monitor to alter its habits. Why, it knew not; but, just as a tired child sinks into a sleep, the gorged and full-fed caterpillar sank peacefully into a dormant state."

Of course all this may have been written in joke. The writer may possibly be laughing at evolutionists. The "inward monitor" of the "gorged and full-fed caterpillar" undoubtedly looks rather suspicious, but one hardly likes to hint at anything so serious. Evolutionists will, I dare say, repudiate such "evolution" as a mere travesty, but it is quite time that half-a-dozen evolutionists who agree on main points should clearly state their belief.

In conclusion, let me ask you as students of nature's processes, whether you have not seen enough to convince you that the revival of the assumption which has been abandoned and reintroduced many times during the last few centuries, that the lifeless is the sole origin of the living—that in fact the non-living and the living are one—is now unjustifiable, and cannot be reasonably entertained. This monstrous fallacy, though taught with the greatest confidence, is based on assumption, and is supported by arbitrarily selected facts, and by not a few misrepresentations and dogmatic assertions. Whenever any form of this false doctrine has been successfully forced into popularity, it has led to the adoption and propagation of the most grievous errors and grotesque conceits.

COMET OBSERVATIONS AT PRINCETON.

The weather has been so unfavorable at Princeton, that we have been unable to make any very satisfactory measures upon the spectrum of the comet. On Saturday evening the comet was visible fairly for an hour or so, before it descended into a bank of cloud. On Sunday evening it was beautifully seen for about half an hour, and then was obscured by a fog which still continues.

The spectrum of the nucleus is very bright. It is apparently continuous, though there may be a little special emphasis at the points where the usual carbon lines ought to appear. The spectrum of the coma and of the tail is precisely like that of most comets, showing three bands which coincide sensibly with those given by the flame of a Bunsen gas-burner, presumably due to a hydrocarbon of some sort.

On Saturday evening the nucleus looked much like a star-fish, having five projecting points formed by jets of light protruding from the central globe to a distance of from four to ten seconds of arc. These jets were not equal in length or brightness, and were not symmetrically disposed with reference to the axis of the comet's tail. Two of them were somewhat curved, they were all diffuse and blunt at the extremity, rather than pointed.

On Saturday, instead of jets, the nucleus had a nearly circular envelope surrounding it, sharply defined from the coma. Its diameter was perhaps 20″, but the fog came on before any measures could be made. This disc of light, surrounding the nucleus, was not uniformly bright:—it was more brilliant on the side next the Sun, and there was a curious dark opening in it of oval form, some 20° one side of the axes of the tail. We were preparing to study the spectrum of this envelope critically, when we were cut off by the mist.

Although the Comet is now receding from both Sun and Earth, it is rising so much higher in the Northern Sky each night, that if the weather becomes favorable, it may yet be possible to get something more satisfactory; but just at present the rain is pouring and the prospect is rather dreary. C. A. YOUNG.

PRINCETON, N. J., *June* 27, 1881.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

LOCUSTS AND SUN SPOTS.

To the Editor of "SCIENCE:"

SIR: Perhaps you will permit me to explain one inapposite word occurring in my communication on the above subject.

When I stated that European migrants come north and east, I should rather have said *north and west*, the set of the migrations, as far as known, is on European areas north and west; and in this direction, butterflies, sphinx moths and locusts, whose point of departure has been traced to Southern Asia or Northern Africa, travel periodically; the occurrence being made known to us by their vanguard, so to speak, sweeping over the eastern shore of Great Britain. That this track is not voluntarily chosen by instinct, but rather due to a prevailing south-easterly direction of the winds, rests now-a-days on a great amount of experience. A. H. SWINTON.

GUILDFORD, ENG., *June*, 1881.

THE BLUE COLOR OF THE SKY.

Prof. Cornu having established the fact that the atmosphere of the earth exercises an energetic absorption upon the ultra-violet rays of the spectrum, whose limit varies according to the statement of the atmosphere and the altitude of the sun. Prof. Hartley sought to attribute this limitation to the influence of ozone. His experiments have demonstrated.

1.—That the ozone is a normal constituent of the higher atmosphere, where it is more abundant than on the earth.

2.—That this quantity of atmospheric ozone suffices to limit the spectrum in the ultra-violet region, without considering the absorption caused by the great density of the oxygen and nitrogen.

3.—That the blue tint of the atmosphere is due to the presence of ozone.

In respect of this last point, Prof. Hartley remarks that, if the ozone exists in the high regions of the atmosphere, the light reflected by clouds at a great heighth has a blue appearance because it traverses a gas of this color. It is so likewise with the light illuminating the distant portions of a landscape. Experiments have shown that 25 milligrammes of ozone for every square centimeter of a layer of 80 kilogr. thick can produce this phenomenon.

WE learn that Prof. H, S. Prichett, Director of the Glasgow Observatory, has been appointed Professor of Mathematics in Washington University, St. Louis, Missouri.

DOLBEAR'S NEW TELEPHONE SYSTEM.

Among the exhibits at the forthcoming International Electrical Exhibition at Paris, the new telephone we are about to describe will command attention as an original and important invention.

It embodies the most recent discoveries of Professor A. E. Dolbear, of Tuft's College, Massachusetts, who, as one of our most esteemed contributors, needs no introduction to the readers of "SCIENCE."

The advantages claimed by Professor Dolbear may be summarized as follows:

1. It is a *new* and independent system which has important advantages over the Bell and other Telephonic methods.

2. Its capability of transmitting speech over longer lines of wires than has been hitherto employed, and its freedom from the troubles of induction.

3. It is a silent instrument, the words coming out clear without the sputtering aud confused noises of the old system.

4. It is an absolute departure from the Bell system, and its principles of operation entirely independent.

We are enabled to place before our readers a description of this original telephone prepared by Professor Dolbear himself, illustrated by some excellent cuts loaned to us by Mr. H. C. Buck, who is leaving for Paris to represent Professor Dolbear at the forthcoming Electrical Exhibition.

Before describing Professor Dolbear's Telephone in detail, we may state that in order to receive messages by the Bell system it is necessary to use between the ear and the line wire an electrical machine, consisting of a magnet, a magneto-coil to influence the magnet, which coil is connected with the line wire and with the ground. Take out this machine, and we take out the Bell telephone system—this is substantially what Professor Dolbear claims to do—for to receive a message, he takes out the machine, and puts the end of the telegraph wire directly to the ear. For convenience of ordinary use Professor Dolbear provides the receiving end of his telegraph wire with a small handle, in which he arranges a couple of thin diaphragms, one of them attached to the wire—a contrivance that improves the vocal delivery of the line wire.

Professor Dolbear thus describes his invention:

RECEIVER.

This consists, in its simplest form, of two metallic disks about two inches in diameter, so mounted as not to be in metallic contact, and this is effected by turning a flange in a hard rubber case so they may be kept apart by it (see Fig. 1). A cap is screwed down upon each plate, one of them having a small hole in the middle of it to listen at; the other is a larger one, having a knob turned upon it for conveniently holding it in the hand. Through the middle of the knob a screw is sunk which touches the back plate and serves to adjust it to the best position relative to the front or vibrating plate. The back plate is thus fastened at both edge and middle, which prevents it from vibrating, while the front plate is only fast at its edge, leaving the middle free to vibrate.

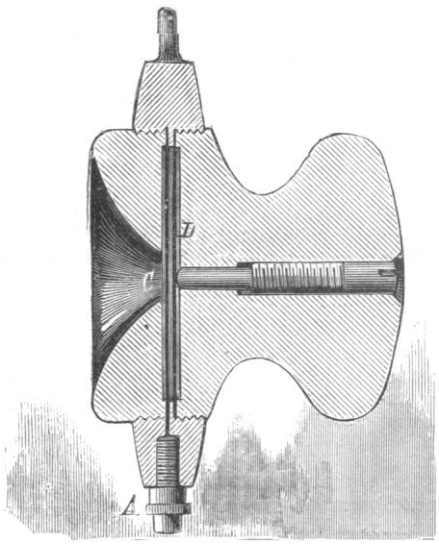

FIGURE 1.

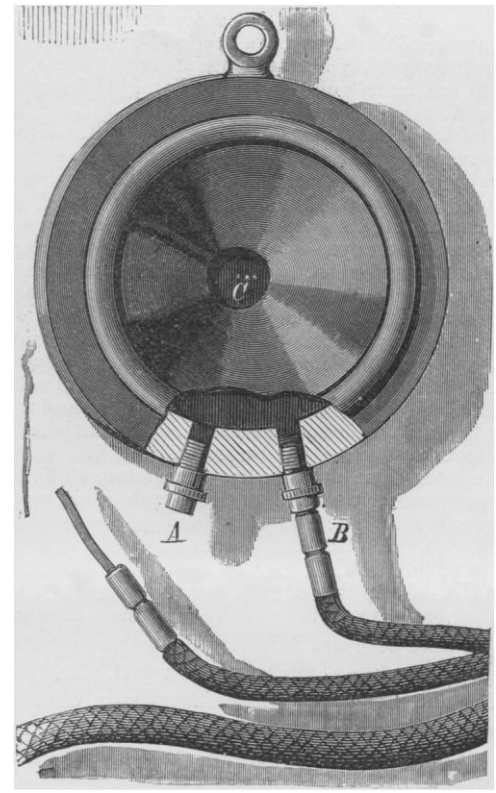

FIGURE 2.

Each of these plates, A B, Fig. 2, is in metallic connection with the induction coil so as to be its terminals. When thus connected and one makes and breaks connection in the primary circuit, a click may be heard by one holding the receiver near to the ear. If a Helmholtz interrupter be employed to make and break the primary circuit, the pitch of the fork can easily be heard, and with a *Reiss transmitter* or other suitable one in the same place, any kind of a sound will be reproduced.

The explanation of this is easily understood from the foregoing description of the conditions present. The electromotive force generated by induction in the coil changes the two terminals in the receiver, one positively, the other negatively; they therefore attract each other.

One of them is free to move, while the other is rigid. The middle of the freer plate consequently moves slightly toward the other whenever they are electrified, and *in so doing spends the energy of the electricity*, while its elasticity brings it back to its place. It is not essential, however, that both of these terminal plates should be connected to the induction coil, for if only one is connected, the recurring charges will cause the free plate to vibrate, for a charged body will attract any other body, so if the connection be to the back plate it will attract the front one and make it move, and if the connection be to the front plate it will attract the back plate and approach it. The effect will be increased by putting the finger upon

the terminal that is free ; not because it *makes a ground*, as it is termed in electrical science, or completes an electrical circuit, for if the individual listening be as perfectly insulated as glass or hard rubber can make him, the sound is as loud as if he stood on the ground ; but the individual becomes electrified by induction, it is the same as enlarging the terminal would be. Consequently receivers are

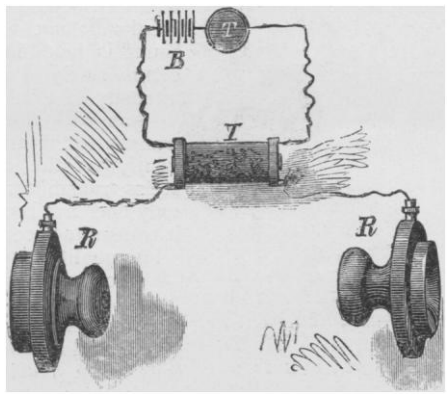

FIGURE 3.

made having only one wire terminal (see Fig. 3), the other plate being connected by a conductor to a metallic ring upon the knob, and this receiver is as efficient as the other.

Electricians will recognize in this structure what is technically known as the *air condenser*, and the mutual attraction of the two plates has been employed as a means of measuring electrical potential. In this case one of the plates is suspended from one arm of a balance, while the other is fixed underneath it at a short distance. The attraction of the plates when they are electrified requires an extra weight to keep them apart, and the weight needed is the measure of the attractive force. But the plates will attract each other when glass or mica or any other non-conducting substance is placed between them in the place of the air ; and one might expect that if such an air condenser would give sonorous results, other forms of condensers, would do so likewise, and this is so. Indeed, whoever has charged a Leyden jar has probably noticed the sounds coming from it when it is nearly saturated. In 1863 Sir Wm. Thompson had his attention directed to the sounds produced by discharge in an air condenser.*

When the two plates of Epinus's condenser are in metallic contact no sounds whatever can be produced by it, but if they are separated by a thin film of air they will

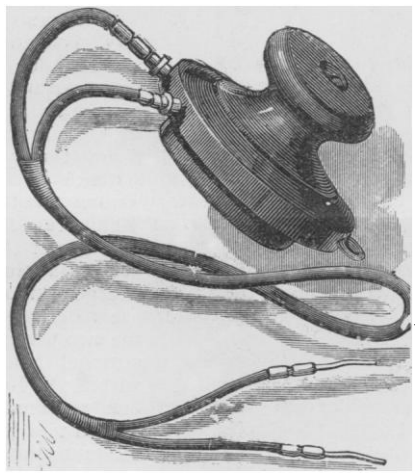

FIGURE 4.

* See papers on Electro-Statics and Magnetism, page 236.

reproduce speech (see Fig. 6, at E). In the first case the electricity passes from one plate to the other without doing work or changing its form ; while in the latter, its form is changed and work is done, and between the best conductors, such as silver and copper and the perfect non-conductor air there are all degrees of conductibility, and whenever electricity spends its energy upon an imperfect conductor it results in heating it; that is, in molecular and atomic vibrations. Consequently an undulatory current from an ordinary transmitter, when sent through an imperfect conductor, will set up sound vibrations in it which may be appreciated by the ear. Let, then, any poor conductor, like a disk of carbon, a sheet of paper or of gelatin, or such chemical substances as ammonium chloride, be placed between the terminal plates, and an undulatory current sent through them will result in sound, and speech may be reproduced.

Now, the phenomena observed in Geissler's tubes and Crooke's tubes show that the residual gaseous molecules are violently impelled from the electrified terminals, not simply because they are electrified, but because they are heated, for the same phenomena are witnessed when the terminals are heated in other ways ; so it is probable that between the plates of the air condenser there is an actual impulsion of the air particles from one to the other, and that the phenomenon of attraction is not isolated from molecular impact. Receivers have been made in which a vacuum could be produced between the plates, but no great difference could be observed in their performance ; and when one reflects upon the immense number of

FIGURE 5.

molecules left in the best vacuum yet produced, it is not a matter for much surprise.

When a non-conductor, such as air, or vulcanite, or mica, separates the two plates, there is a complete transformation of the electricity at the limiting surfaces, and with small condensers the efficiency depends upon the electromotive force employed. For low electromotive forces, such as common batteries of a few cells can give, the effect is almost inappreciable, and for this reason such a receiver as this is quite free from the disturbance known as induction, and which is so troublesome in the magneto-telephone, such induced currents being generally of low electromotive force.

Among the earliest of my experiments, made while developing this method, was to attach one terminal wire from an induction coil to the outer coating of a Leyden jar, taking the other wire from the coil in one hand, and

applying one ear to the knob of the jar. Every word spoken at the transmitter was distinctly heard, but the prickly sensation due to the electricity was too disagreeable. Another receiver, not less curious than the Leyden jar, was found in the pair of insulating handles made for the medical application of electricity. When these were connected to the coil wires, and one held in each hand by the wooden part, while the metallic ends were placed at the ears, any kind of a sound at the transmitter was heard without any difficulty, but of course the same sensation was felt as with the jar. Many forms of condensers have been employed with capacities too small to measure up to two micro-farads, and these in all sorts of relations, charging the plates from batteries, from Holtz machines, charging the line as in cable works, etc., all of which give results that differ only in degree.

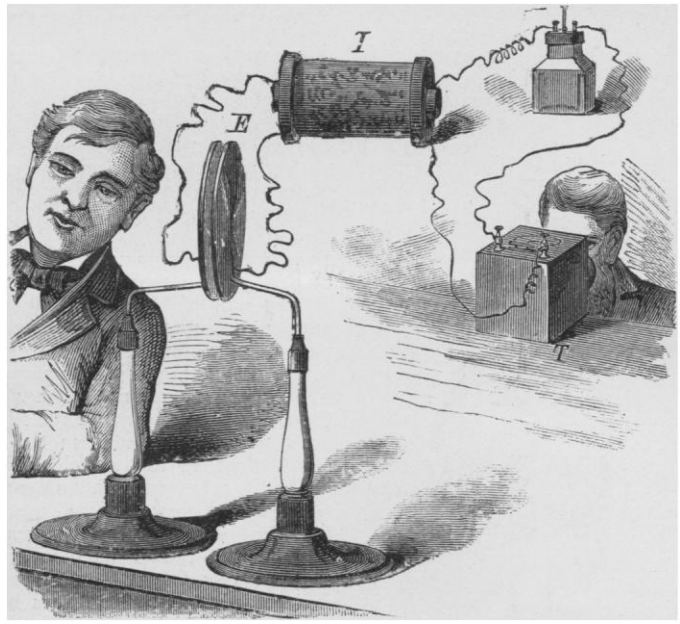

FIGURE 6.

THE TRANSMITTER.

As with other systems in common use, there is a transmitter as well as a receiver. One form of the transmitter is attached to the door of a box containing battery and coil. This transmitter is substantially the same as the one invented by Reiss in 1861. His consisted of a cubical box (see Fig. 6) about five inches on a side, having an opening on one side to talk into, and another one on top, across which the diaphragm was fastened. A pin of platinum was glued to the middle of the membrane, and connected by a wire to a binding screw. A V-shaped wire with platinum point touched upon the platinum of the membrane, and with its binding screw served to complete a galvanic circuit. This one (see Fig. 10) differs from this of Reiss only in making the chamber smaller, making the connecting wire on top T-shaped, and substituting carbon or other suitable substance for the platinum; but the platinum does very well. It is a matter of some surprise that the old transmitter is still spoken of as a *make and break* circuit, and that it can only transmit pitch, whereas, whether it breaks or not when a sound is made in it depends solely upon the intensity of that sound, just as with the Blake transmitter, if one talks gently to the original Reiss transmitter, it not only does not break, but it transmits speech with all its qualities.

Accompanying the transmitter an induction coil is shown at I, Fig. 6, and as the working of the receiver depends upon electromotive force and not upon current, it is necessary, if a coil be used to raise the electromotive force, to have one with many more turns than is needed with the magneto receiver, and the best results have been obtained with a coil having a resistance of four or five thousand ohms, but it is probable that this will be reduced.

On account of the high electromotive force a better insulation is needed than ordinary telegraph lines give, when the induction coil is at the further end of the line, but if it is at the receiving end, and a low electromotive force is employed in the primary, then ordinary insulation will answer. Again, the electromotive force being high, inserted resistances do not so markedly decrease the efficiency of the instrument, as in the case with the magneto-telephone. For instance, the articulation is perfect and loud enough with a resistance of fifty thousand ohms, a resistance equal to five thousand miles of common telegraph wire, and it may be heard through a resistance of a million ohms, practically an infinite resistance.

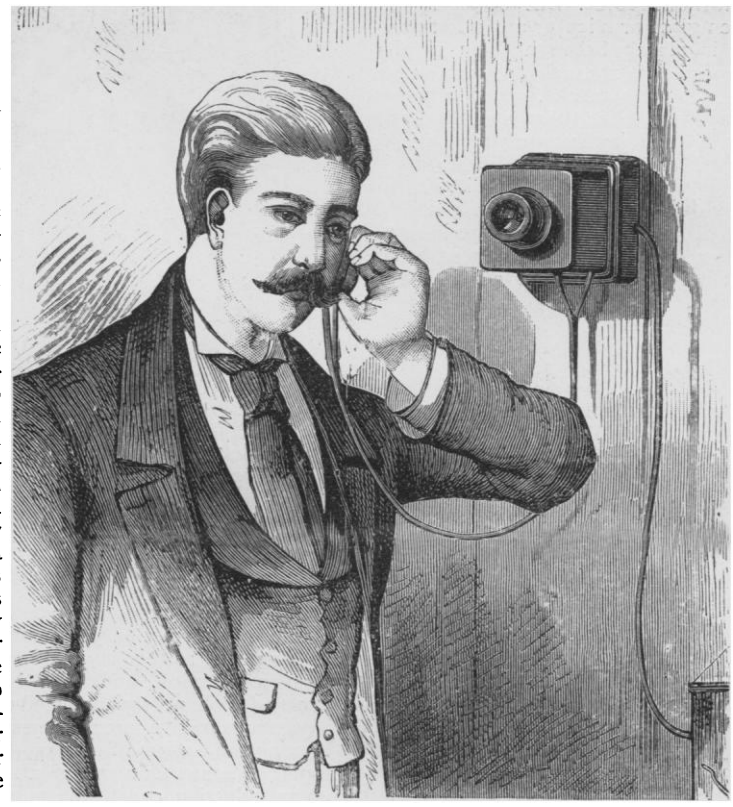

FIGURE 7.

If one of the terminals of a receiver be charged in any way, the reaction between the two plates will be stronger than it will be without. Let, then, one terminal be attached to a knob of a Holtz machine that is kept charged by rota-

tion. The sounds will be heard much louder, and any other source of electricity with high potential will answer the same purpose. Hence a battery of a large number of cells may be substituted for the Holtz machine, and one of the terminals of the battery may go to the ground, though this is not essential. This arrangement will keep the terminal plate charged to the potential due to the chemical relations and number of cells in the battery. If the battery be placed in the line wire it will keep both ends of the line charged. A Volta's pile may be substituted for the battery in either place, and so may a charged condenser of any capacity, the electrically

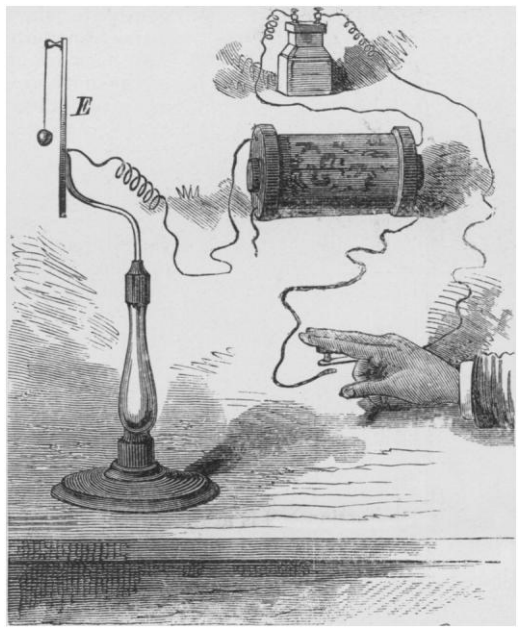

FIGURE 8.

charged terminals in this system acting in a way analogous to the permanent magnets in the magnetic system.

There are various other ways of employing condensers, and as one would infer from the preceding descriptions of the phenomena, these condensers will talk, that is, they will reproduce in sound the varying electrical conditions to which that may be subjected, as will also either a battery or a Volta's pile.

I have often heard them talk, and have made many experiments with such receivers.

By this system telephonic communication can be secured through ordinary medical electrodes.

In perfecting this new telephone Professor Dolbear has given long and constant study to the scientific problems involved, while the mechanical construction has been prosecuted by Mr. H. C. Buck, aided by skilled machinists and competent assistants. The above concise description in the inventor's own words will give our readers a clear understanding of the principles that underlie his interesting invention, and it only remains for us to describe in brief the several figures in our front page engraving.

Fig. 7 shows the telephone in actual use, the transmitter being secured to the wall, the battery and induction coil being placed in a box on the floor, or in a convenient closet. Fig. 4 is a perspective view of the new receiver; Fig. 2 a face view of the same, with a portion of the casing broken away to show the connection of the two binding posts, A B, with the diaphragms, C D, and the adjusting screws by which the distance between the diaphragms is regulated are shown in the sectional view Fig. 1.

Fig. 8 illustrates the principle of electrical attraction upon which the action of the new receiver is based; the electrostatic charge received by the plate, E, from the induction coil attracts the pith ball suspended in front of the plate.

Fig. 6 shows the two plates, E, of an Epinus condenser, placed near together and connected with the terminals of the secondary wire of the induction coil, I, and used as a telephone receiver.

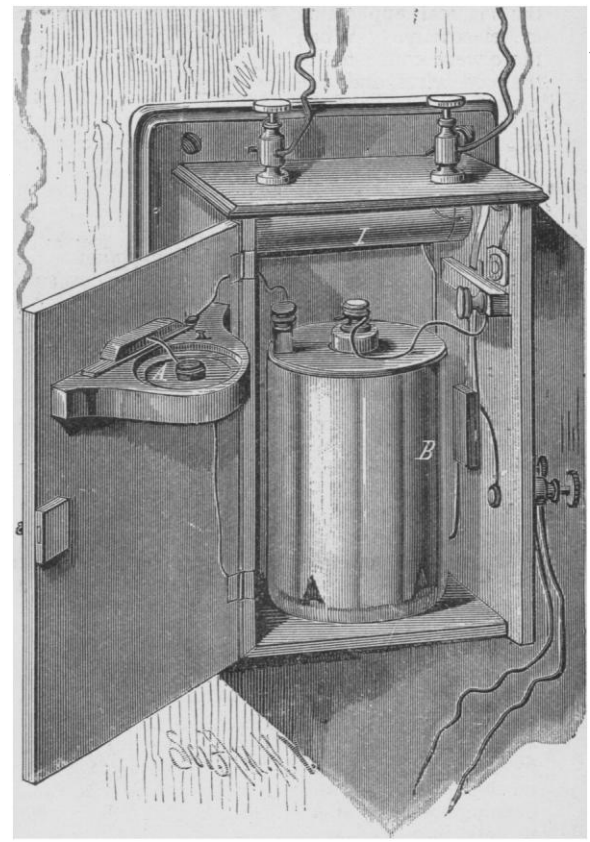

FIGURE 9.

Fig. 5 illustrates the essential features of the new telephonic system. I being the induction coil whose primary is in circuit with the battery, B, and transmitter, T, the receivers, R, are each connected with a single terminal of the secondary wire of the coil, I.

Fig. 9 shows Professor Dolbear's experimental telephone transmitter. In this instrument the diaphragm, A, is horizontal, and carries a carbon electrode, upon which rests a moveable carbon electrode connected by an arm with a delicately pivoted bar supported by the diaphragm cell. The local circuit is from the battery, B, through the carbon electrodes, and through the primary of the induction coil, I.

EXTRACTION OF SILVER.—To extract the silver from silvered objects, these should be plunged into a bath composed of a mixture of 100 grammes of finely pulverised saltpetre and 1000 grammes of sulphuric acid. If the acid is weak, the copper and the other metals except the silver will be attacked; if the acid is concentrated the silver alone will be dissolved.

UPON A MODIFICATION OF WHEATSTONE'S MICROPHONE, AND ITS ADAPTABILITY TO RADIOPHONIC RESEARCHES.*

By Alex. Graham Bell.

In August, 1880, I directed attention to the fact that thin discs or diaphragms of various materials become sonorous when exposed to the action of an intermittent beam of sunlight, and I stated my belief that the sounds were due to molecular disturbances produced in the substance composing the diaphragm.[1] Shortly afterward, Lord Raleigh undertook a mathematical investigation of the subject, and came to the conclusion that the audible effects were caused by the bending of the plates under unequal heating.[2] This explanation has recently been called in question by Mr. Preece,[3] who has expressed the opinion that, although vibrations may be produced in the discs by the intermittent beam, such vibrations are not the cause of the sonorous effects observed. According to him the aerial disturbances that produce the sound arise spontaneously in the air itself by sudden expansion due to heat communicated from the diaphragm—every increase of heat giving rise to a fresh pulse of air. Mr. Preece was led to discard the theoretical explanation of Lord Raleigh on account of the failure of experiments undertaken to test the theory.

He was thus forced, by the supposed insufficiency of the explanation, to seek in some other direction the cause of the phenomenon observed, and, as a consequence, he adopted the ingenious hypothesis alluded to above. But the experiments which had proved unsuccessful in the hands of Mr. Preece, were perfectly successful when repeated in America under better conditions of experiment, and the supposed necessity for another hypothesis at once vanished. I have shown in a recent paper read

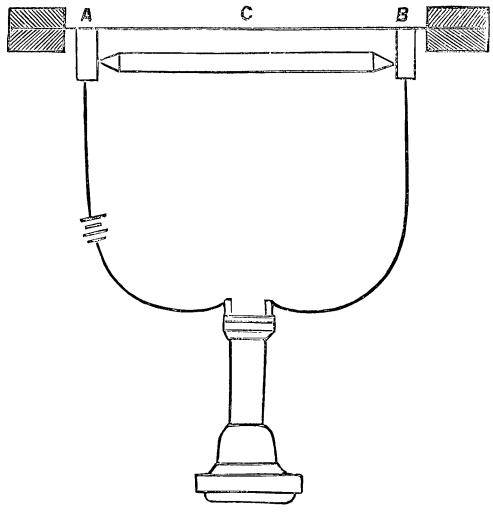

Fig. 1.

before the National Academy of Science[4] that audible sounds result from the expansion and contraction of the material exposed to the beam, and that a real to and fro vibration of the diaphragm occurs, capable of producing sonorous effects. It has occurred to me that Mr. Preece's failure to detect with a delicate microphone the sonorous vibrations, that were so easily obseerved in our experiments, might be explained upon the supposition that he had employed the ordinary form of Hughes' microphone shown in Fig. 1, and that the vibrating area was confined to the central portion of the disc. Under such circumstances it might easily happen that both the supports, *a b*, of the microphone might touch portions of the diaphragm which were practically at rest. It would, of course, be interesting to ascertain whether any such localization of the vibration as that supposed really occurred, and I have great pleasure in showing to you to-night the apparatus by means of which this point has been investigated.

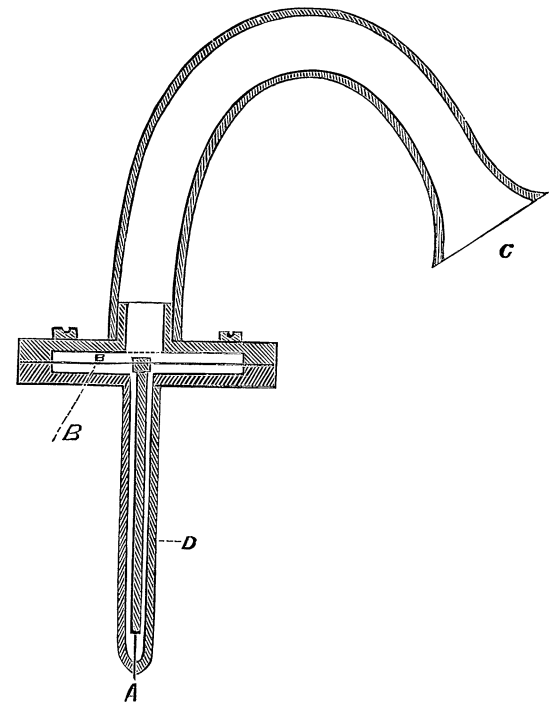

Fig. 2.

The instrument is a modification of the form of microphone devised in 1827 by the late Sir Charles Wheatstone, and it consists essentially of a stiff wire, *A*, one end of which is rigidly attached to the centre of a metallic diaphragm, *B*. In Wheatstone's original arrangement, the diaphragm was placed directly against the ear, and the free extremity of the wire was rested against some sounding body—like a watch. In the present arrangement, the diaphragm is clamped at the circumference like a telephone-diaphragm, and the sounds are conveyed to the ear through a rubber hearing-tube, *c*. The wire passes through the perforated handle, *D*, and is exposed only at the extremity. When the point *A* was rested against the centre of a diaphragm upon which was focussed an intermittent beam of sunlight, a clear, musical tone was perceived by applying the ear to the hearing-tube *c*. The surface of the diaphragm was then explored with the point of the microphone, and sounds were obtained in all parts of the illuminated area and in the corresponding area on the other side of the diaphragm. Outside of this area on both sides of the diaphragm, the sounds became weaker and weaker until, at a certain distance from the centre, they could no longer be perceived.

At the points where we would naturally place the supports of a Hughes' microphone (see Fig. 1) no sound was observed. We were also unable to detect any audible effects when the point of the microphone was rested against the support to which the diaphragm was attached. The negative results obtained in Europe by Mr. Preece may, therefore, be reconciled with the positive results obtained in America by Mr. Tainter and myself, A still more curious demonstration of localization of

* A paper read before the Philosophical Society of Washington, D. C. June 11, 1881.

[1] American Association for Advancement of Science, August 27, 1880.

[2] Nature, vol. xxiii., p. 274.

[3] Royal Society, March 10, 1881.

[4] April 21, 1881

vibration occurred in the case of a large metallic mass. An intermittent beam of sunlight was focussed upon a brass weight (1 kilogram), and the surface of the weight was then explored with the microphone shown in Fig. 2. A feeble but distinct sound was heard upon touching the surface within the illuminated area and for a short distance outside, but not in other parts.

In this experiment, as in the case of the thin diaphragm, absolute contact between the point of the microphone and the surface explored was necessary in order to obtain audible effects. Now, I do not mean to deny that sound waves may be originated in the manner suggested by Mr. Preece, but I think that our experiments have demonstrated that the kind of action described by Lord Raleigh actually occurs, and that it is sufficient to account for the audible effects observed.

ASTRONOMY.

On the 23rd ultimo, Mr. E. L. Larkin, a subscriber and contributor to this journal, telegraphed to Professor Swift, of Rochester, the discovery of a comet in the constellation of Auriga; but as others have since made the same claim, the priority of discovery awaits confirmation by those who dispense the pecuniary reward offered by Mr. Warner for all comets discovered during the present year.

We reserve until next week our report on this interesting celestial object, by which time our correspondents will have worked out the results of their observations, which have been delayed by atmospheric and other difficulties. The comet is now plainly visible, and American astronomers are on the alert to thoroughly examine it with all the appliances which modern science has placed at their command. At the date of our writing nothing reliable has been determined by actual observations, but some interesting facts, based on preliminary and partial observations, have been communicated, which, if accepted with reserve, pending final results, may be found useful to those directing their attention to the comet.

Professor Henry Draper is said to have made several successful photographs of the erratic stranger. Professor C. A. Young, of Princeton, has examined its spectrum, and reports that that of the nucleus was continuous, while that of the coma was sensibly coincident with the spectrum of the Bunsen burner flame. As seen directly in the 9½ inch equatorial, with eye-pieces of the lowest power, on the evening of the 26th, the nucleus was small and bright, with five bright jets of unequal length projecting from it a short distance. The tail showed three maxima of brightness, of which the brightest was near the axis, and was quite convex in the direction of increasing right ascension. On the 26th he states the spectrum was about the same, but the nucleus, instead of showing jets as before, was nearly surrounded by an envelope.

Professor Boss of the Dudley Observatory determines the diameter of the nucleus to be seven seconds or 1500 miles, at an estimated distance of 45,000,000 of miles.

Professor Asaph Hall considers it most probable that the comet is identical with that discovered by Professor B. A. Gould at Buenos Ayres of the 1st of June. On the 26th ultimo an observation was made at the naval observatory, Washington, which indicated "the position of the comet at its lowest culmination, obtained with the transit circle, was at 11 h. 27. P. M., Right ascension 5 h., 48 m., 384-100 s., North declination, 57 deg., 40 m., 52 sec.

THE LUNAR ECLIPSE.—The eclipse of the moon on June 11 was seen under favorable conditions at the Naval Observatory, Washington. The only observations of importance were observations of occultation of B. A. C. 5862, and two faint stars during the eclipse.

THE OHM.

A British Association committee has been reappointed for the remeasurement of the Ohm, and of other units. It is not to their work, however, that we wish now to draw attention, but rather to a good stroke in the right direction, done in the Cavendish laboratory by Lord Rayleigh with the assistance of Dr. Schuster and others. The old British Association apparatus has been fitted up again, with such improvements as the criticism of nearly twenty years has suggested. It will be remembered that this is the only method in which the measurement of transient currents by ballistic galvanometers is not employed. A circular coil of insulated wire forming a closed circuit rotates about a vertical axis, and the electrical current induced in it by the earth's magnetism gives a steady deflection to a magnetic needle at its centre. The manifold precautions, calculations and corrections which have to be entered into by the experimenters are given by Professor Fleeming Jenkin and others. One important correction is that which is due to the self-induction of the coil which retards the current, and a most important fact has been brought to light by Lord Rayleigh, namely, that this self-induction is considerably greater than it was thought to be by the original committee. Professor Rowland, assuming that an unknown error existed proportional to the square of the speed of the rotation, has found that the original experiments of the committee lead to the result that the Ohm is 0.74 per cent. smaller than it was intended to be, and his own experiments lead to its being 0.89 smaller. Kohlrausch found it nearly 2 per cent. too great, and Weber thought it correct. The Cavendish laboratory experiments lead to its being 1.05 per cent. too small, and the elaborate paper to the Royal Society in which this result is given promises a redetermination with new apparatus on the same principle. In making the present determination a new method of suspension of the needle, a stroboscopic method of measurement of the speed—the old governor and the tinkling bell being discarded—and driving the coil by means of a water turbine instead of by hand, are some of the improvements which have been introduced.

It is to be remembered that no re-measurement of the Ohm can ever effect our use of it as a standard. It is no longer to be regarded as exactly equal to one thousand million C. G. S. units, but this is of no more consequence than the fact that one gramme is no longer regarded as being exactly equal to the mass of a cubic centimetre of water at 4° C.—*The Electrician.*

ALCOHOL IN WATER AND AIR.

An interesting discovery has been brought before the Academy of Sciences by M. Muntz, Chief of the laboratories belonging to the Agricultural Institute. He has found that alcohol is distributed throughout the universe, in the sun, air, water of the ocean and streams. It is a known fact that fermentation is a general phenomena in air, water and earth; This fermentation gives off CO^2, and as a necessary consequence, alcohol. This is what the experiments of M. Muntz have demonstrated; he has been able to prove the presence of alcohol in water, etc., by reducing the alcohol to an *iodoform* state by means of iodate and carbonate of soda. The precipitate which is obtained even in the presence of a millionth quantity of alcohol, affects the crystalline form of the snow examined under the microscope. The alcohol is produced in earth containing organic matter in decomposition, and hence it extends into the waters of streams, and into the atmosphere. Still, the portions are so infinitesimal that a water-drinker will never feel himself "alcoholized;" the dose of alcohol contained in a cubic metre of water (1000 litres), being at the most a gramme.—

ELASTIC RESTORATION OF CAOUTCHOUC.—Objects made of this substance easily lose their elasticity. Dr. Pol, however, avers that their elasticity may be restored by plunging them for an hour into a mixture composed of 2 parts of water and 1 part of ordinary ammoniac.

THE TELEPHONIC RECEIVER.

Mr. Preece has presented to the Royal Society the result of his investigations upon radiophony. They relate to the phenomena produced by the action of intermittent rays upon discs and vases of different substances. Confirming and pursuing the investigations of Mercadier in France, and of Tyndall, he has come to the conclusion that the sounds produced under these conditions are due to calorific effects, and not to light.

Caoutchouc and ebionite (hardened caoutchouc), are absolutely opaque, but they act as diathermics or tranparencies for calorific rays; the radiating heat can act through a screen of these materials.

It has been proved by delicate experiments, that six vibrations or more can be produced during a second, by the intermittent action of the heat, producing a dilitation of the disc's mass. The phenomena, therefore, produced by Bell and Tainter are not due to an absorption of heat, changing the volume of the affected substance.

Mr. Preece made use of a specially constructed chamber and is convinced that the sounds are produced by the contained air, and not by the discs or surfaces of the chamber. In it is placed a mechanism which recalls that by which the "moulinet" of Crook's radiometre is moved under the influence of the heat.

He has proved, finally, that the absorbing for the heat of the gas, contained in the chamber experimented on, influences the production of the sounds. These experiments have been repeated upon bottles blackened with camphor smoke, both on their exterior and interior surfaces.

Mr. Preece has thus been led to think that a wire of platinum, traversed by an intermittent current, can become a source capable of producing on suitable walls calorific rays, which have the power to cause sounds through the heating of the gas on contact with these walls.

The experiment was crowned with success; it was made at first by sending currents into a spiral of platinum by means of a stop-wheel turned with the hand, and when a good microphone was substituted a reproduction of the wood was effected.

Thus has been realized a receptive telephone founded upon an entirely new principle.—(*La Nature*).

ALTERATION OF MILK.

M. Fauvel, in the capacity of chemist to the municipal laboratory of Paris, has discovered that the milk employed for babes often undergoes an alteration which has hitherto been unsuspected. In his investigations he has noted the presence of cryptogamic vegetations. These are found in the tubes of glass and caoutchouc, which enter into the construction of the small feeding apparatus, especially so in the swelling of the rubber which the infant sucks. The new microphite can be easily cultivated in whey, and the author has thus observed the various stages of its development. This, however, is but the first of M. Fauvel's intended investigations. This discovery is important from a hygienic point of view. These observations were confirmed by the fact that twenty-eight out of thirty-one cases presented these symptoms. (*La Nature.*)

NOTES.

FIRE BALLS.—There are many persons who persist in their statement that fire-balls exist only in imagination; but here is the authentic statement of Henry O. Forbes, who, in a letter to *Nature* thus describes the phenomenon.

"I was standing in a window on the second floor of the Hôtel Braganza (in Lisbon), which stands close to and high above the Tagus, and had an unbroken view of the river. There occurred a flash followed by an instantaneous crash, but the tail of the flash, however, gave origin to two balls, which descended separately and not far apart, towards the river, and when quite close to, or in contact with the water, burst in rapid sequence, with explosions which might have been the crack of doom."

PHOSPHORESCENCE.—Mr. W. Crookes, after submitting the action of precipitated aluminum to the action of electric discharges in a Geissler tube, announces that a phosphorescence similar to that obtained from the ruby was developed. This is, evidently, the reproduction of the phenomena obtained, a long while ago, by M. Edw. Becquerel by means of the solar light. Mr. Crookes, indeed, adds that the aluminum, if sufficiently electrified, passes from an amorphous state into a crystalline structure, a fact quite credible, and that it assumes at the same time a rose shade kindred to that of the natural ruby, a tint very difficult to understand.

EFFECTS OF TEMPERATURE UPON MAGNETISM.—Mr. John Trowbridge has just completed the following experiment in the physical laboratory of Harvard University. He submitted a bar of iron to a great cold of 60° cent. below zero, obtained by evaporating CO^2. He proved that the decrease of magnetism, suspected by Wiedeman, if the bar be at a lower temperature than that allowing magnetic impregnation, is indeed a demonstrated physical fact. The bar, which had been magnetized at 20° C. below zero, had lost almost ⅔ of its magnetism after 47 minutes of exposure to this cold. He also observed that, by keeping a bar of steel for a certain time at a temperature of 20° cent., 50 per cent of its primitive magnetism was restored.

PREECE ON FAURE'S BATTERY.—Mr. Preece, the electrician, is not favorable to Mr. Faure's battery. He remarks that although it possessed considerable force its resistance was very feeble and it could therefore give a powerful current. He dwells especially upon "time" as a factor in electric experiments. A strong current of one minute duration can be readily obtained, but for purposes of lighting, something more durable is needed. It is a pretty thing, but for to-day it is not practical.

THE AURORA BOREALIS.—The idea that the Aurora Borealis gave forth a distinctly audible sound was hitherto regarded as absurd. Physicists, however, are beginning to acknowledge it as a fact. "*Nature*," of London has a few letters on the subject. There seems to be two opinions as regards the nature of the sound produced. One party pretends that the noise is analogous to the rustling of silk, the other party compares it to the sound of crackling flames. The question however will shortly be solved by means of baloon ascensions that are now being made.

ACTION of Light upon Phosphorescent Bodies.—M. Clémandot.—The author maintains that phosphorescence is a purely physical phenomenon, due to a vibratory action exercised chiefly by the blue ray of light. He connects these phenomena of vibration in phosphorescent bodies with those which light occasions in organized bodies.

NOTE.

I wish some one would begin with the start given by the paper on polarization of sound, in "SCIENCE" for May 14, and thoroughly go through the subject of Etherial Physics.

The mechanics and elementary laws of action of the Ether substance are needed.

The seemingly rotary or spiral course pursued by the particles conveying light and electricity, as shown in the polarization of light and in that of magnetism, are especial subjects of choatic conception. And there is more beyond! SAMUEL J. WALLACE.

NOTICE TO CORRESPONDENTS.

The writer of a paper "*On Ether*" received by us, will much oblige by forwarding his name and address.

SCIENCE

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